

Web table F Critical appraisal and results for all included studies

The studies are listed in alphabetical order according to the lead author's surname or institutional name where appropriate. The notation 'NA' denotes where the box is not applicable to the study.

All studies were critically appraised using the general critical appraisal criteria (1-9) (see webappendix 2). Qualitative studies additionally were appraised using criteria 10-12 (see webappendix 4) and economic impact studies with criteria 13-15 (see webappendix 3). The relevant criteria for each study are listed in the table below with criteria met and not met demonstrated. Where a critical appraisal criterion is not listed it is not applicable to the study. The critical appraisal tool questions relevant to each criterion are shown below the table.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Athanasopoulos ²	Repeat cross sectional study [NA]	2000 Olympics (Sydney)	Level 2+ 4 5 6 7 8 [1 2]	NA	Funded by Tourism Research Australia and the Sustainable Tourism Co-operative Research Centre	Economy There was a significant increase in domestic business travel in the 3 months following the Games ($p<0.05$, actual change not reported), but no significant change in holidays, visiting friends or relatives or 'other' forms of domestic tourism (as measured using a questionnaire). The three time series models predict that domestic tourism will either increase by 0.61% or decrease by 1.78% or by 2.11% between 2005 and 2014 as compared with the predicted increase of 8.41% by the Tourism Forecasting Council.

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Baade ³	Repeat cross sectional study [NA]	1984 Olympics (Los Angeles) & 1996 Olympics (Atlanta)	Level 2- 1 4 8 [2 3]	NA	Not stated	Economy The authors report that the Los Angeles Olympics was associated with the creation of 5,043 additional jobs during 1984, but none in other years. The Atlanta Olympics is associated with the creation of a total of 42,448, 21,767 or 3,467 jobs in the 3 models. When opportunity costs and displacement were accounted for, the most optimistic model created an additional 24,742 permanent jobs (a mean of \$63,860 per created job). In the other two models there was a net loss of 4,540 or 29,301 permanent jobs. These figures included full-time and part-time jobs. It is not clear which model fitted the changes in consumption best.

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Berman ⁴	Repeat cross sectional study [NA]	2000 Olympics (Sydney)	Level 2- 1 4 5 6 7 8 [2 3]	NA	Not stated	Economy There was an insignificant increase in the 'All Ordinaries Accumulation Index' (overall stock market) trend of 0.8% following the Sydney announcement (p=0.29). Four industry sectors did have a significant change stock market value (Building materials increased by 2.0% p=0.0003; Developers and contractors increased by 2.8% p=0.0001; Engineering increased by 1.8% p=0.033; Miscellaneous services increased by 1.5% p=0.0095). For these four sectors, only the New South Wales-based companies (identified by the location of the head office) had a significant change in their trend value (p=0.02 as compared to p=0.40 for non-New South Wales-based companies). This amounted to an increase of 2.2%.

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Brown ⁵	Cross sectional study and Qualitative [13 Local Education Authorities (LEAs), 13 Local Authorities (LAs) & 16 Sport governing bodies (SGBs)]	2002 Commonwealth Games (Manchester)	Level 2- (CSS only) 2 10 [1 8 11 12 13]	The Wider Opportunities Programme (WOP) was a range of initiatives including education projects, festivals, coaching, volunteering and workshops for sports groups. All LAs participated in the relay and most in the volunteering. Most LEAs participated in the YST tolink programme, the spirit of friendship festival and the millennium volunteers project but few in the seminars or conference. The participation of SGBs was generally low	UK Sport	Recreation It was reported that the involvement of local authorities, local education authorities and sports governing bodies in the WOP was generally low and was limited by funding constraints, a lack of dedicated staff, the lack of capacity within most voluntary sports organisations to harness any benefits of the Games, a lack of ability to retain staff after the Games and poor communication of information. There were a number of examples of initiatives that provided an ongoing sports development legacy that were created or catalysed by the Games and the WOP. Where these positive impacts were felt, they were described as being close to the Games venues with dedicated funding from local authorities or local education authorities. The inability of many organisations to associate themselves with the Games because of concerns about sponsorship hampered attempts to gain a benefit from the Games (a parallel community branding and sponsorship scheme was suggested to resolve this issue). The trends in the use of the new facilities built for the Games (aquatics centre, tennis centre, squash centre, velodrome and Belle Vue leisure centre) are all positive between opening and 2003/4 (although the 'wet use' of the aquatics centre decreased it was compensated for by a greater increase in 'dry use'). It is not known who is using the facilities and what impact this has had on existing facilities. There is the suggestion that a large proportion of the use has been by elite athletes and by people outwith the local area. The Games stadium was

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Brunet ⁶	Repeat cross sectional study [NA]	1992 Olympic Games (Barcelona)	Level 2- 4 8 [1 2 5 6 7]	NA	Not stated	<p>Housing The mean price of new housing in Barcelona increased from 67,260 to 228,471 peseta/m² from 1986 to 1992 in Barcelona, before decreasing to 230,756 peseta/m² by the end of 1993. The price of other (secondhand) housing rose from 60,163 peseta/m² in January 1986 to 214,230 peseta/m² in June 1991.</p> <p>Economy The retail price index rose by 64.1% in Barcelona, by 53.2% in Catalonia and 51.7% in Spain between 1985 and 1992. Barcelona unemployment decreased from 125,694 in 1986 to 66,295 in 1991 before increasing to 69,941 in 1992, and the number employed increased from 582,078 in 1986 to 656,575 in 1991 before decreasing to 645,833 in 1992. The registered unemployment rate decreased by 47.8% in Barcelona, by 50.6% in the Province of Barcelona, by 46.7% in Catalonia and by 25.8% in Spain as a whole between 1986 and 1992. The population of Barcelona increased by 1.1% between 1986 and 1993. The increase in the number of tourist visitors staying in Barcelona hotels increased steadily from 1,616,484 in 1989 to 1,874,734 in 1992. The number of hotel beds increased from 18,569 to 25,641 between 1990 and 1992 whilst bed occupancy decreased from 58% to 54%.</p> <p>Transport The mean number of passengers during the Olympic period compared with the same period in 1991 increased by 61% for RENFE railways,</p>
As submitted by author						<p>Web extra <i>BMJ</i> 2010;340:c2369</p>

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Decker ⁷	Repeat cross sectional study [NA]	2002 Winter Olympics (Salt Lake City)	Level 2+ 4 5 6 7 8 [1 2]	NA	Not stated	Crime The demand for police services (as measured by police calls) did not vary significantly between the 73 week pre-event period (4,553/week), the three week event period (4,635/week) and post-event period (4,679/week). Police-generated incidents (i.e. recorded crime) decreased significantly between the pre-event and event period (-15% from 1,344 to 1,141/week; p<0.01) before significantly increasing again between the event and post-event periods (+18% to 1,341/week; p<0.01). Similarly, the rate of arrests significantly decreased between the pre-event and event periods (-47% from 407 to 216/week; p<0.001) and significantly increased between the event and post-event periods (+76% to 381/week; p<0.001). Analysis of the time trends using an 'ARIMA' model and adjustments for seasonality found that there was a significant increase in citizen demand for police services (calls to police) during the Games but also a significant reduction in police recorded incidents and arrests (p<0.001). There was no significant change in the type of crime reported between the time periods.

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Downward ⁸	Cross sectional study [1,300]	2002 Commonwealth Games (Manchester)	Level 2-4 [1 2 8 9]	NA	UK Sport	Recreation In a study of event volunteers, 6.7% of respondents agreed that they now do more sport (whilst 66.7% disagreed) and 6.0% agreed that they participate in new sports (whilst 74.7% disagreed). 8.3% said they agreed that they do more hours as a sports volunteer and 12.3% agreed that they volunteered for new sports (whilst 74.1% and 67.1% disagreed). 15.6% agreed that they volunteer in a wider range of activities/organisations now whilst 63.4% disagreed.
ERA ⁹	Input Output economic model [NA]	1984 Olympics (Los Angeles)	Level 2-4 [1 8 14 15 16]	NA	Not stated	Economy The total economic impact of the Games was \$2.298bn (\$0.766 primary impact and \$1.532 induced impact). This is calculated to have generated 73,375 years of employment and \$1.268bn in wages. \$50m of organising committee surplus was invested in the LAOOC Amateur Athletic Foundation.

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Faber Maunsell ¹⁰	Repeat cross sectional study [NA]	2002 Commonwealth Games (Manchester)	Level 2-4 [1 2 5 6 7 8]	NA	North-West Development Agency	Economy Employment change in East Manchester (excluding self-employed) increased by 4% (from 33,360 to 34,820) between 1999 and 2000. This was substantially accounted for by increases in public administration, education and health (+14% to 14,090 jobs) and distribution, hotels and restaurants (+14% to 8,230 jobs) despite a reduction in manufacturing employment of 29% (to 5,050). The number of UK residents' trips to Greater Manchester, the North West and England decreased by 6.4%, 2% and 3.9% respectively between 2000 and 2002 whilst the number of trips to these areas by foreigners changed by +7.4%, +3.8 and -4.4% over the same period. The number of UK residents overnight stays in Greater Manchester, the North West and England changed by +7.2%, -3.2% and -5.3% whilst overseas visitor overnights changed by -2.2%, -2.1% and -3.2% between 2000 and 2002. The total tourism spend changed for UK visitors by 21.3%, 17.3% and 4.5% and by 28.9%, 4.0% and -9.2% between 2000 and 2002 for Greater Manchester, the North West and England.

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Fidell ¹¹	Repeat cross sectional study [22 people in 12 houses]	1996 Olympics (Atlanta)	Level 2- 4 5 6 8 [1 2 7 9]	NA	US air force with additional advice from air traffic services, the civil aviation authority and NASA.	Transport and Environment The number of outdoor noise events in the range of 61dB to 91dB was higher before and during the Olympics than after, and higher in the range of 61dB to 75dB for indoor noise events (although it is not clear if these are rates or if variations in collection time have been accounted for). The number of outdoor noise events for each 5 dB interval during the event was up to 700 more than after the event, and up to 250 more than before the event for each 5dB interval. The excess of number of indoor noise events before the event was up to 200 more than after the event and 100 more than during the event. The mean number of push-button confirmed awakenings was 1.8 per subject-night pre-Olympics; 1.3 during the Olympics; and 1.0 post-Olympics. There was a significant correlation between indoor noise events and arousal ($R^2=0.64$) and outdoor events and awakening ($R^2=0.77$) but no significant correlation between indoor events and awakening or outdoor events and arousal.

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Friedman ¹²	Repeat cross sectional study [NA]	1996 Olympics (Atlanta)	Level 2- 1 4 5 6 7 8 [2] The transport data does not meet criterion 1	Not stated	Not stated	Health The number of acute care childhood asthma events during the Olympics decreased significantly by 41.6% in the Medicaid claims file (RR 0.61 95%CI 0.44-0.85) and decreased insignificantly in an health maintenance organisation file (by 44.1%; RR0.56 (95% CI 0.31-1.02), in two paediatric hospitals (by 11.1%) and in the Georgia hospital discharge database by 19.1% as compared to 4 weeks before and 4 weeks after the Games. It is unlikely that this was due to migration effects since non-asthma acute events varied by between -3.1% and 1% only. Peak daily ozone concentrations decreased by 27.9% (p<0.001) and peak weekday traffic counts by 22.5% (p<0.001). Traffic counts were correlated with ozone concentration (r=0.36) and meteorological conditions did not differ substantially from the base period.

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Giesecke ¹³	Computable general equilibrium economic model [NA]	2000 Olympics (Sydney)	Level 2- 4 5 6 7 15 16 [1 2 8 14]	NA	Not stated	Economy There was a 12% increase in tourism demand (economic spend) in New South Wales during the year of the Games in comparison to the rest of Australia, but the demand was 2.2% lower for the next three years before becoming equivalent. There is therefore no evidence for an induced tourism impact beyond the year of the event. The CEA model concludes that the economic impact on Australia is negative (in present value terms \$2.1bn for Australia accounted for by a -0.04% deviation from real GDP baseline from 1997 to 1999, -0.06% until 2001 and -0.01% until 2006). There was no impact on Australian employment, although consumption decreased and investment increased. For New South Wales there was an increase in real GDP of 0.19% from 1997 until 2001 (except for 1999/2000 for which it was 0.08%), before decreasing to -0.02% in 2001/2 and then stabilising at -0.01% until 2006. This was largely due to increased investment and was offset by sustained large decreases in real private and public consumption.

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Giuliano ¹⁴ As submitted by author	Cross sectional study [4,900]	1984 Olympics (Los Angeles)	Level 2- Nil [1 2 4 8 9]	General transport system management consisted of: venue site traffic management; spectator information; freeway closure management; public information campaign for commuters, businesses and shippers; system traffic management including removal of roadworks and opening auxiliary lanes; and system monitoring. For trucks there was: a temporary withdrawal of restricted night deliveries; a voluntarily agreement with Teamsters Union to accept regular	California Department of Transport	Transport During the Olympics between 15.9% and 23.9% of respondents did not work at their regular workplace. The proportion on vacation ranged from 9.5% to 13.8%; the proportion utilising an alternative workplace varied between 2.8% and 3.7%; with smaller proportions modifying their working week pattern, being off sick or not attending work for other reasons. The mean commute to work during the games took 36.8 minutes (5.6 minutes/14% less than normal) and commute home took 42.2 minutes (6.4 minutes/13% less). 23.3% of respondents left for work earlier than usual; 65.1% at the same time; and 11.6% later. 17.9% of respondents left for home earlier, 72.6% at the usual time and 8.2% earlier than usual. There was a flatter and earlier distribution of the proportion of people leaving for, and arriving home from, work during each half hour time period in the mornings (with higher proportions in the earlier time periods and a smaller overall peak). The proportion of employees that had their working hours specified for them reduced from 56.2% before the Olympics to 41.3% during the Olympics. The window of allowed arrival and departure times to and from work was widened during the Olympics compared to other times. The number of stops made by respondents was almost unchanged on the way to work (27.3% to 27.4%) and decreased (39.9% to 37.5%) on the way home during the Olympics. Web extra BMJ 2010;340:e2369

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Hallenbeck ¹⁵	Repeat cross sectional study [NA]	1990 Goodwill Games (Seattle)	Level 2- 2 6 [1 4 7 8]	NA	Not stated	Transport The impact of the Games on traffic volumes in Tacoma and Seattle was not statistically different from before or after the event in all but three monitoring locations (where traffic volumes were significantly lower by approximately 2,500-3,000 vehicles per day), although specific traffic incidents caused congestion on some days. Traffic speed was unchanged at Tacoma but increased on the SR-520. Bus passenger numbers increase by 10% in comparison to the previous year. Requests for transport information overwhelmed supply (both Metro and road traffic inquiries). There is a suggestion that the increase in traffic patrols identified and dealt with incidents more rapidly. There is evidence that people changed their transport plans as part of a mitigation strategy.

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Hargreaves ¹⁶	Repeat cross sectional study [NA]	1992 Olympics (Barcelona)	Level 2- 1 [2 3 4 5 6 7 8]	NA	ESRC and Leverhulme Foundation	Culture The proportion of the Catalan population identifying themselves principally with Catalonia decreased from 45% to 37% between 1990 and 1996 at a time when regional identification had increased elsewhere in Spain from 20% to 21%. The corresponding identification with Spain increased from 16% to 24% amongst Catalans at the time when Spanish identification elsewhere remained constant at 27% between 1990 and 1996.
HBOS ¹⁷	Repeat cross sectional study [NA]	1992-2004 Olympic Games	Level 2- 4 [1 2 5 6 7 8]	NA	HBOS (mortgage lender)	Housing There were house price increases of 49%, 7%, 11% and 9% in Barcelona, Atlanta, Sydney and Athens respectively in the 5 years before hosting the Games in addition to the national increase in house prices in these nations.

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Hensher ¹⁸	Repeat cross sectional study [NA]	2000 Olympics (Sydney)	Level 2- Nil [1 2 4 5 6 7 8]	NA	Not stated	Transport The mean travel time during the Games was substantially reduced as compared with the previous year. The reductions were from 64 to 33; 57 to 28 and 80 to 57 minutes for the M4/Parramatta Road, Victoria Road and Cumberland Highway respectively in the morning. The afternoon reductions were from 56 to 33 and from 45 to 35 minutes from the M4/Parrameter Road and Victoria Road. No afternoon data from the Cumberland Highway is presented.
Hiller ¹⁹	Repeat cross sectional study [NA]	1988 Winter Olympics (Calgary)	Level 2- 6 7 8 [1 2 4 5]	NA	Not stated	Housing The population of both Victoria Park Stampede and Victoria Park East declined steadily from 546 and 2,593 in 1968 to 12 and 825 respectively in 1997. This decline is reflected in a similar decline in housing units from 228 in Victoria Park Stampede and 1,204 in Victoria Park East in 1968 to 7 and 414 respectively in 1997. It is suggested that these declines resulted from the pursuit of mega-events since property speculation was encouraged and investment discouraged.

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Hopkins ²⁰	Repeat cross sectional study [NA]	1996 Olympics (Atlanta)	Level 2- 4 8 [1 2 5 6 7]	The intervention was the creation of the urban camping ordinance (law). The degree to which this was implemented is reported in the outcomes.	Not stated	Housing 279 citations were issued under the urban camping ordinance over 12 months with a higher incidence in the mornings (69% between 7am and 1pm) and in the summer months (with July accounting for 25% of the total number). 58% of the citations were issued following arrests in public parks, with 27% of the total in the park at 419 Peachtree Street (opposite a homeless centre). 73% of the citations were issued to African Americans, 24% to Caucasians and 2% to Latinos. 94% of the citations were issued to males. Only 12% of the citations were issued to repeat offenders. 20% of those arrested provided an address within the Atlanta metropolis although many of these were found to be invalid. The number of citations used against homeless people was less than expected given that there is an estimated 15,000 homeless in Atlanta each night.

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Hotchkiss ²¹	Repeat cross sectional study [NA]	1996 Olympic Games (Atlanta)	Level 2- 1 4 5 6 7 8 [2 3]	NA	Nil	Economy Employment increased 17% more in counties close to Games venues as compared to venues distant to venues within Georgia ($p<0.01$). The evidence on differences in wages (7% increase in comparison to areas distant to venues) cannot be attributed to the Games because of the high degree of variability in the wages data. The effect was not simply due to metropolitan growth since a comparison of the Atlanta area with other Southern USA metropolitan areas revealed an 11% ($p<0.01$) increase in employment.

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Indig ²²	Repeat cross sectional study [NA]	2000 Olympics (Sydney)	Level 2- 4 6 [1 2 5 7 8]	NA	Not stated	Health The mean daily number of presentations to hospital with illicit drug related problems was significantly more (p=0.04) during the Olympics with 13.3 compared with 8.8 in the 2 weeks beforehand. Presentations peaked 24 hours after the closing ceremony (at 35/day) and were higher at the weekends (16.6 compared to 9.2, p=0.001). There was a significant increase in mean daily presentations for ecstasy and amphetamines (5.1 compared with 1.7, p=0.007) but not for heroin (4.5 compared with 4.2, p=0.8) during the Olympic period compared with the two weeks prior to the Olympics. Most of the presentations were in males (67%) and young people (61% of men and 69% females were under 30 years). Over 90% of presentations were Australian residents and 83% were from the Sydney metropolitan area. Two deaths were recorded (one related to heroin and one to ecstasy). The recordings for the Olympic surveillance system were significantly different from the routine hospital system limiting comparisons with other time periods.

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ISER ²³	Input output economic model [NA]	2001 Special Winter Olympics (Anchorage)	Level 2- 4 [1 2 8 14 15 16]	NA	Not stated	Economy \$18.8million was added to the Alaskan economy as a result of the Games, equivalent to 379 jobs for a year. The greatest number of jobs created was in retail (75), construction (36) and business services (31). The construction impacts were seen prior to the event and many of the retail impacts during and after. The Anchorage Municipality received \$0.18million additional revenues from various taxation sources.
Kang ²⁴	Repeat cross sectional study [NA]	1988 Olympics (Seoul)	Level 2- 1 4 8 [2 5 6 7]	NA	Not stated	Economy The regression model fit improved from 0.457 to 0.655 in the five country model (South Korea, Japan, Taiwan, Hong Kong and Thailand) and from 0.348 to 0.438 in the four country model (excluding Thailand) with the addition of the mega-event variable, indicating an important impact of the Olympics in explaining tourism trends (p<0.05). The modeled impact of this is an increase in tourism market share of 1.2% in the year of the event, 3.5% in 1989 and 2.8% in 1990 (and falling steadily thereafter). This amounts to a (direct) economic impact of \$1.3billion for these three years. No total impact is presented.

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Kasimati ²⁵	Macro-economic model [NA]	2004 Olympics (Athens)	Level 2+ 4 5 6 7 8 14 15 16 [1]	NA	Funded by IOC and Greek ministry of national economy and finance	Economy The GDP growth attributable to the Games between 1997 and 2005 was a mean of 1.34% per year. Unemployment decreased by a mean of 1.88% per year from 1997 to 2005 as a result of the Games (amounting to a reduction of 86,300 individuals per year). The model predicts that the additional GDP growth resulting from the Games between 2006 and 2012 will be a mean of 0.49% whilst unemployment will fall by 0.17% per year (7,700 individuals per year).
Kemp ²⁶	Cross sectional study [400]	1994 Winter Olympics (Lillehammer) & 2000 Olympics (Sydney)	Level 2- Nil [1 2 3 4 8]	NA	Not stated	Volunteering Most volunteers perceived that they had developed social skills and personal networks (64.5%), acquired job skills (79% in Lillehammer and 88% in Sydney) and enhanced their knowledge about society (55%).

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Kim ²⁷	Input output economic model [NA]	1988 Olympics (Seoul)	Level 2- Nil [1 4 5 6 7 8 14 15 16]	NA	Not stated	Economy The total economic impact between 1982 and 1988 is calculated as being 2,383 billion won (1,108 billion won as direct impacts and 1,274 billion as indirect impacts) and 336,000 jobs. This is equivalent to 0.4% of GNP and 0.3% of total employment over the same period. GNP grew by 5.4%, 12.3%, 12.0%, 12.1% and 8.5% between 1985 and 1989.
Kolstad ²⁸	Repeat cross sectional study [NA]	1994 Winter Olympics (Lillehammer)	Level 2- Nil [1 2 4 5 6 7 8]	NA	University and Olympic documentation service	Culture There was no significant change in the value systems of the Lillehammer residents after the Games.
KPMG ²⁹	Computable general equilibrium model [NA]	2006 Commonwealth Games (Melbourne)	Level 2+ 4 8 14 16 [15]	NA	Office of the Commonwealth Games Co-ordination	Economy There was an increase in Gross State Product of \$1.6bn over 20 years and an additional 13,000 person years of FTE employment, with a total of 22,000 casual jobs during 2006.

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Lee ³⁰	Repeat cross sectional study [NA]	2002 Asian Games (Busan)	Level 2- 8 [1 2 4 5 6 7]	Restriction of passenger vehicles to alternative day operation only during the event (based on registration plate numbers). The implementation of this is not stated other than vehicle counts.	University of Ulsan, Korea	Transport and Environment Passenger vehicle numbers decreased by 4.7% (+/-0.8%) during the study period (29/9/02-14/10/02) as compared to the periods before and after (13/9/02-28/9/02 and 15/10/02-30/10/02). Mean vehicle speeds increased during the Games from 24.6 to 28.3km/h. Carbon monoxide (CO) levels during the Games were 1.25, nitrogen dioxide (NO ₂) 1.45, ozone (O ₃) 1.01, PM10 (particles measuring 10µm or less) 1.78 and sulphur dioxide (SO ₂) 1.40 times the levels of the period before the Games. Meteorological conditions were more conducive to the accumulation of air pollution during the Games and this may provide some explanation for the otherwise paradoxical outcomes.

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Lee ³¹	Repeat cross sectional study [NA]	2002 Asian Games (Busan)	Level 2+ 2 4 5 6 7 8 [1]	Restriction of passenger vehicles to alternative day operation only during the event (based on registration plate numbers). The degree to which this was implemented was not stated.	Supported by Ministry of Environment	Health, Transport and Environment The relative risk of hospitalization for asthma during the post-Games 3 week period over the baseline period (the three weeks before the Games and the 16 days of the Games) was 0.73 (95% CI 0.49-1.11). In 2003 the relative risk of admission between the time periods was 1.78 (95% CI 1.27-2.48). Air pollution was reduced by 1-25% in the post-Games period compared to the Games and pre-Games period in 2002. This was in contrast to rises in pollutants comparing the time periods in 1999, 2000, 2001 and 2003 with the exception of ozone (O ₃) which decreased in the comparison for each year except 2003. There was no difference in weather variables between the comparison years. The relative risk of admission was significantly associated with nitrogen dioxide (NO ₂) (1.35 95% CI 1.01-1.80), sulphur dioxide (SO ₂) (1.34 95% CI 1.06-1.68), PM10 (particles measuring 10µm or less) (1.34 95% CI 1.13-1.60) and ozone (O ₃) (1.24 95% CI 1.04-1.48) but not with carbon monoxide (CO) (1.01 95% CI 0.74-1.38).

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<p>London East Research Institute³² (continued from above)</p> <p>As submitted by author</p>						<p>The proportion of households in the lowest income quintile was higher in Atlanta than in other US cities between 1969 and 1999 with a large increase in Atlanta from 24% to 34% between 1969 and 1979 before declining steadily to 29% by 1999. The US city average increased steadily from 22% to 24% from 1969 to 1999. The mean unemployment rate for Barcelona was comparable to Spain between 1989-1993 (approximately 15%) and 1999-2003 (approx 10%) but was higher between 1994 and 1998 (20% v 12.5%). The unemployment rate in Atlanta was approximately 1% lower than the US mean and fluctuated in parallel with it between 1990 and 2004 before becoming the same as the US rate in 2005. The unemployment rate in Sydney was approximately 1.5% lower than the Australian average in 2001 with the gap narrowing to less than 0.5% by 2004 against a general declining trend for both. Unemployment in Attica (Athens region) was approximately 0.5% higher than in Greece as a whole in 1999 before steadily declining to become approximately 1% less than Greece by 2005 against a declining trend for both. Inflation in Barcelona mirrored that of Spain between 1986 and 2006 with the exception of 1989-1994 where the rate was 1-2% higher, peaking in 1992. The inflation rate in Atlanta was approximately 1% below the US city average between 1990 and 1992 and from 2002 to 2005 and mirrored the US city average between 1992 and 2002. The New South Wales inflation rate was almost identical to the Australian inflation</p>

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
London East Research Institute ³² (continued from above)						<p>Housing</p> <p>House prices in Barcelona rose from approximately (US) \$1,250/m² in 1989-93 to \$2,600/m² in 1999-2003. The average house price in Atlanta was approximately the US city average in 1990 but rose by approximately \$50,000 by 2000 whilst the US city average rose by approximately \$25,000. The Atlanta average house price then rose by another \$70,000 by 2005 but there is no US city comparator given.</p> <p>Australian and New South Wales house prices rose between 1996 and 2005, with the most rapid rise between 2002 and 2004 (from approximately \$10,000 to \$17,000) with the gap between to the Australian prices from the higher NSW prices rising from approximately \$2,000 to \$4,000 over the series.</p>

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Lumsdon ³³	Qualitative [not clear]	2002 Commonwealth Games (Manchester)	Level NA 10 11 13 [1 2 8 9 12]	NA	Not stated	Volunteers Some volunteers felt that they received inadequate training and some that there was inadequate supervision. There was concern expressed that too much time was spent rehearsing or between tasks and that volunteers were frequently under-utilised or were not appreciated sufficiently by the paid staff, management or in respect to organisational arrangements such as breaks and catering. Some volunteers described strong feelings of comradeship and appreciation from the public. There was no significant change in the type or extent of volunteers' participation in sport or voluntary work between the pre-event survey in 2002 and 2003.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Lybbert ³⁴	Repeat cross sectional study [NA]	1980 & 1988 Winter Olympic Games and 1984 & 1996 Olympic Games	Level 2- 1 4 5 6 7 [2 3 8]	NA	Not stated	Demography and Economics Net migration to all of the Olympic regions is positive [1.63% (95% CI -1.81%, 6.86%) net increase before the Games and 0.84% after (95% CI -1.29%, 6.21%)] with the Summer Olympics having a larger positive effect [2.17% before the Games (95% CI -0.04%, 6.86%) and 1.71% after the Games (95% CI -0.70%, 6.21%)] than the Winter Olympics [0.84% before the Games (95% CI -1.81%, 6.54%) and 0.13% after the Games (95% CI -1.29%, 6.21%)]. The regression models suggest that employment increased by around 1% before and after the Games and that per capita economic growth may be negative at -1% before and -1.3% after the event although the derivation of these results is much less clear.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
MORI ³⁵	Repeat cross sectional study [4,084 (2002); 4118 (2003)]	2002 Commonwealth Games (Manchester)	Level 2- 1 4 [2 3 5 6 7 8 9]	NA	Not stated	Recreation The proportion of the population participating in sports activities (except walking) 4 or more times in the 4 weeks after the Games compared with before insignificantly decreased across the 4 sample areas when combined (-2.0% (95% CI -4.1% to 0.0%)); and decreased significantly in Blackburn [-9.0% (95% CI -13.2% to -4.7%)]; decreased insignificantly in Liverpool [-3.0% (95% CI -7.3% to 1.3%)] and Greater Manchester [-3.0% (95% CI -7.3% to 1.3%)]; and increased significantly in Congleton (7.0% (95% CI 2.7% to 11.3%)); representing an increasing socioeconomic difference. The proportion participating in sport at least once in the last 12 months decreased in 2 areas [Greater Manchester by 2.0% (95% CI -6.4% to 2.3%) and Blackburn by 11.0% (95% CI -6.7% to -15.3%)], was static in Liverpool (0.0% change, 95% CI -4.3% to 4.3%) and increased by 7.0% (95% CI 3.0% to 11.1%) in Congleton. Participation rates were higher for men than women and in the higher social classes. Volunteering rates increased by 3% in Congleton and Liverpool, remained static in Manchester and declined in Blackburn (reported narratively).

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Mount ³⁶	Cross sectional study [650]	1988 Winter Olympics (Calgary)	Level 2- 2 [1 4 8 9]	NA	Calgary Convention and Visitors Bureau	Economy 91% of respondents said that the upcoming Olympics had no effect on the planning of their new business. 56% reported some positive effect from the Olympics and 14% reported that they get business from the Olympic facilities or the athletes they attract. Those reporting these positive effects tended to be the larger companies with sales of greater than \$1million per annum.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Newby ³⁷	Repeat cross sectional study	2002 Commonwealth Games (Manchester)	Level 2-1 [2 3 4 5 6 7 8]	NA	Not stated	<p>Economy Unemployment in East Manchester declined from 18.1% to 9.8% between 1996 and 2002 in proportion with the national and regional declines (Manchester declined from 8% to 4%; North West England from 7% to 3%; Great Britain from 6% to 3% (all figures approximate as read from graphs)). The proportion of people with a perceived net household income (excluding housing benefit) of >£200 per week in East Manchester increased from 17% to 34% between 1999 and 2002 and the proportion perceiving themselves to be in financial difficulty decreased from 49% to 26%.</p> <p>Recreation Resident satisfaction (not clear which residents) with the provision of parks and green spaces increased from 28% to 75% between 1999 and 2002.</p> <p>Crime Reported vandalism to own property decreased from 19% to 13% between 1999 and 2002.</p> <p>Housing Resident satisfaction with access to supermarkets increased from 75% to 89%; the proportion believing the area is improving increased from 17% to 52%; the proportion believing the area is getting worse decreased from 52% to 30%; reported satisfaction with their home increased from 75% to 82%; and reported their home was in good condition increased from 53% to 75% between 1999 and 2002. It is not clear whether all the relevant outcomes from the residents</p>

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
O'Brien ³⁸	Qualitative [74]	2000 Olympics (Sydney)	Level NA 10 11 12 13 [Nil]	The intervention consisted of networking initiatives in three Australian regions (Canberra, Hunter Valley and Gold Coast). Canberra and the Gold Coast based their initiatives within sport departments and Hunter within the economic department. Hunter had a more explicit strategy of creating business networks whilst Canberra and Gold Coast were interested more in attracting public investment in facilities and in training camp visitation. Canberra outsourced the tasks of co-	Not stated	<p>Economy The Hunter Valley region developed numerous business links, as perceived by stakeholders, due to an explicit business networking strategy based on the visit of Olympic teams to pre-event training camps in the areas. This was seen to a lesser extent in the Gold Coast and Canberra who viewed the visits as more sports orientated and either outsourced the co-ordination or left it to the Sports Department. The positive networking results perceived in Hunter were tempered by the failure to maintain the co-ordinating group or the employment contract of the main facilitator after the event. This study confirms that many perceive the Sydney Olympics as a prime business networking opportunity.</p> <p>Web extra <i>BMJ</i> 2010;340:c2369</p>
As submitted by author						

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
O'Brien ³⁸	Qualitative [92]	2000 Olympics (Sydney)	Level NA 10 11 12 13 [Nil]	The interventions were business leveraging initiatives associated with the Games including: Australia Open for Business; Business Club Australia; Australian Technology Showcase; Olympic Business Roundtable; and The Business Project. Most of these were perceived to have been implemented as planned.	Funded by Sustainable Tourism Cooperative research centre with is an Australian Government initiative	Economy There was a concerted effort by government agencies and business to gain a positive impact from contact with business representatives from across the world at the Sydney Games. Reflection on these attempts suggests that most is to be gained from the creation of sustainable networks rather than from trade during the Games. It is suggested that effective business leveraging requires: strategic activity aimed at the identification of sports tourists and the networks that they inhabit; attention to integrative structures that facilitate collaboration between businesses; creation of a supportive environment for learning and relationship building; and recognition of the complexity of the networks present at a mega-event.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Owen ³⁹	Qualitative [11]	2000 Olympics (Sydney)	Level NA 10 11 12 [13]	NA	Not stated	Democracy Features of governance in the run up to the Sydney Olympics included: centralisation of planning powers, the increased involvement of the private sector in government activities, relaxation of the planning process, reduced transparency, reduced accountability and reduced public participation. This loss of democracy was tempered where civic activism was present. Those communities where activism was a feature were more likely to secure significant benefits from the Games.
Pitts ⁴⁰	Input output economic model [NA]	1998 Gay Games (Amsterdam)	Level 2- Nil [1 2 4 8 14 16]	NA	Not stated	Economy The direct economic impact on Amsterdam was \$350.7million based on a median daily expenditure of \$146 for 10 days, with an additional 5 days spent in neighbouring cities, and 11,610 participants (after adjusting for casuals, time switchers and locals); and 197,250 visiting spectators.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Potter ⁴¹	Repeat cross sectional study [NA]	1996 Olympics (Atlanta)	Level 2+ 5 6 7 8 [1 4] The data for ozone meets criterion 1 but not 2 or 3	The traffic management arrangements consisted of: supplementary public transport (including 24 hour bus and rail, park and ride with express buses to venues and additional services); a demand management campaign (encouraging alternative commuting habits); additional high occupancy vehicle lanes and Intelligent Transportation System infrastructure; and traffic restrictions in central Atlanta. The degree to which this was implemented was	Not stated	Traffic and Environment Total daily traffic volumes (as compared to the mean for June 1st - August 31st excluding the Olympic period of July 13 - August 1st) were reduced by 0-10% during the first week of the Olympic period with some locations recording an increase and some a decrease of up to approximately 7% in the second week. Peak traffic volumes were substantially lower (approximately 5-30%) during the Olympic period and during the previous week. The statistical significance of these results was not tested. There was a statistically significant (level not stated) mean reduction in ozone in the Atlanta test sites of 18% during the Olympic period as compared to the rest of the summer. It is not clear what confounding is represented by the meteorological data in the model. There were large decreases in ozone levels in the comparison areas in neighbouring states of 10-28%. The prevailing wind during this time was westerly indicating that the largest reductions could not be accounted for by a reduction in emissions from Atlanta. It is therefore unclear as to whether the reduction in ozone levels was due to prevailing meteorological conditions, reduced traffic or other factors. Web extra <i>BMJ</i> 2010;340:c2369
As submitted by author						

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Preuss ⁴²	Repeat cross sectional study [NA]	2000 Olympics (Sydney)	Level 2- 1 5 8 [2 3 4 6 7]	NA	Not stated	Economy The cost of living increased in Australian cities (Sydney, Melbourne, Brisbane, Adelaide, Perth) in equal measure during Olympic year (an approximate 6% rise in prices) before returning to pre-event levels (approximately 3%) in the following two years. Sydney did not experience a differential effect.
Searle ⁴³	Repeat cross sectional study [NA]	2000 Olympics (Sydney)	Level 2- 8 [1 2 4 5 6 7]	NA	Not stated	Economy New South Wales capital expenditure on recreation and culture increased by 144.2% in the period 1996/7-1998/9 as compared to 1993/4 to 1995/6. This compares to an increase of 1.6% in health capital expenditure and a decrease of 18.1% in education capital expenditure. Capital expenditure in the period 2000/1 to 2002/3 compared with the period 1996/7 to 1998/9 decreased by 65.1% for recreation and leisure and increased by 7.7% and 40.5% for health and education capital expenditure respectively.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Shin ⁴⁴	Repeat cross sectional study [NA]	1988 Olympics (Seoul)	Shin 2+ 4 5 6 7 8 [1 2]	NA	Not stated	Health Against a backdrop of a seasonal but declining suicide rate, there is no evidence to suggest a change in suicide behaviour at the time of the Olympics. The proportion of variation explained by the addition of the Olympic variable was 0.04% and insignificant.
Simon ⁴⁵	Cross sectional study [NA]	1996 Olympics (Atlanta)	Level 2- 4 [1 2 8]	NA	Not stated	Health 263 children from outwith the local catchment area were seen between the 13th July and the 13th August 1996. The mean age was 6.7 years. 24% were seen in tertiary care centres and 76% in urgent care centres. The children originated from 23 countries with 15 primary languages. 44% were uninsured and the proportion requiring admission was higher than the proportion of local residents (27% vs 13% at the tertiary hospital and 7% vs 3% at the county hospital).

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Smith ⁴⁶	Repeat cross sectional study and Qualitative [RCS is NA; Qualitative = 20]	2002 Commonwealth Games (Manchester)	Level 2- (RCS only) 4 8 10 [1 2 11 12 13]	The intervention was the Legacy Programme funded by Single Regeneration Budget managed through Local Authorities and City Councils. The degree to which it was implemented was not stated.	Not stated	Economy The legacy programme was reported to have created 220 jobs; generated recognised qualifications for 3,092 people; assisted 8,473 businesses; helped 913 voluntary organizations; and encouraged 2,607 individuals to participate in voluntary work. It was suggested that projects helped engage people better than previous initiatives. Teenagers, ethnic minorities, retired and people with special needs were perceived to have been given opportunities to access training and employment experience. It was also perceived to have raised aspirations, confidence and self esteem, fostered a sense of regional identity, broken down barriers and enhanced community organisations. Four of seven projects were still continuing to be delivered at the time of the study.
Spilling ⁴⁷	Repeat cross sectional study [NA]	1994 Winter Olympics (Lillehammer)	Level 2- 1 3 8 [2 4 5 6 7]	NA	Norwegian government	Economy The annual number of guest nights increased by 100% between 1989/90 and 1995 for Lillehammer and its two neighbouring municipalities (59% in Lillehammer; 225% in Oyer and 76% in Gausdal). This is a rise from approximately 400,000 to 800,000 bed nights.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
State of Utah Governor's office ⁴⁸	Repeat cross sectional study [NA]	1988 Winter Olympics (Calgary) and 1996 Olympics (Atlanta)	Level 2- Nil [1 2 4 5 6 7 8]	NA	Funded by State of Utah	Economy The occupancy rate for Atlanta's lodging industry was slightly lower in 1996 at 68% than in 1995 when it was 71%, although revenue during July and August was higher in 1996 (\$1.3bn) than in 1995 (\$1.1bn) with most of the excess gained during the Olympic months. Revenues were 5-10% higher in 1997 than in 1995. The number ski visits dropped by approximately 20% in Calgary during January and February in 1988 as compared to 1987 but otherwise followed an almost identical trend.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Sterken ⁴⁹	Repeat cross sectional study [NA]	1984 – 1996 Olympic Games	Level 2- 1 4 5 6 7 8 [2 3]	NA	Not stated	Economy Host nations for the Summer Olympic Games between 1984 and 1998 (inclusive) experienced median percentage excess real GDP growth of -0.682, -0.492, -0.256, 0.144, 1.241, 1.345 and 0.644 in the 7 years prior to the event, -1.077 in the year of the event, and -0.323, 1.010, -0.314, -1.563, -0.867, 1.374 and 0.544 in the 7 years following the event over the world growth median (none statistically significant). When correction was made for host nation growth and in comparison with Olympic participating nations only, the excess percentage excess real GDP growth rate was 0.300, 1.740, 1.417, 0.104 in the 4 years prior to hosting the event; 1.881 in the year of the event; and 1.744, 2.534, 0.883, 0.964 in the 4 years following the event (with the second year after the event being the only statistically significant difference).

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Teigland ⁵⁰	Repeat cross sectional study [NA]	1988 – 1994 Winter Olympics	Level 2- 1 4 5 6 7 [2 3 8]	NA	Western Norway Research Institute	Economy The total number of guest nights in the Olympic region was stable at 105,000/month from 1991 to mid-1995. Within this the Olympic satellite sites increased steadily from 25,000 to 50,000/month and Lillehammer itself increased from 20,000/month to 40,000/month at Games time before falling to 25,000/month by the end of 1994 (all figures approximated from graphs). Changes in demand for rooms in establishments >20 beds were significantly explained by GDP growth and during the post-Olympic period (but only for domestic tourism; no level of significance stated). Competing Norwegian destinations' occupancy was explained by GDP growth (for Buskerud only) and the Olympics (positively for Oslo but negatively for Buskerud), indicating a post-Olympic displacement effect. The tourist accommodation occupancy rate in Calgary increased from 53% to 65% between 1983 and 1994 after dipping from over 70% in 1981 (figures approximate). Regression analysis shows that increased prices had a significantly negative effect and domestic demand a significantly positive effect on occupancy, but the Olympic year, or the period following the Olympics had no significant impact (no level of significance stated). Visits to the Olympic facilities in Lillehammer and Olympic museums in Calgary, Albertville and Lillehammer after the Games dropped by approximately 50% every 2-3 years.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Truno ⁵¹	Repeat cross sectional study [NA]	1992 Olympics (Barcelona)	Level 2- Nil [1 2 4 5 6 7 8]	NA	Not stated	Recreation The proportion of the population which does some form of physical or sporting activity at least once a week has increased from 36% in 1983, to 47% in 1989 to 51% in 1995. The proportion of women participating in sporting activity has increased from 35% in 1989 to 45% in 1995.
Tucker ⁵²	Repeat cross sectional study [NA]	1984 – 2004 Olympic Games	Level 2- 5 6 7 8 [1 2 4]	NA	Not stated	Economy There was a significant increase in employment across the pooled time series from 6 years before until 1 year after, with a smaller non-significant positive impact for the 8 years after the event. It is also stated that higher Olympic expenditures are negatively correlated with the size of the effect and that the employment impact is larger in wealthier countries.

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Veraros ⁵³	Repeat cross sectional study [NA]	2004 Olympics (Athens)	Level 2- 1 4 6 8 [2 3 5 7]	NA	Greek Ministry of National Economy and Finance and National Bank of Greece.	Economy There was an increase in the total Athens stock market value of 7.68% (p=0.035) in the week following the announcement (the announcement was made on a Friday evening after the market was closed), with statistically significant increases in the construction sector (12.85%; p=0.0300) and industrial sector (8.97%; p=0.0146) with no significant change in the banking, insurance, closed-end funds or 'parallel' sectors. There was no significant change in the overall stock market in Milan and significant change in only two of the Milanese stock sectors (construction and electrical) which both increased (4.6%; p=0.032 and 5.4%; p=0.031 respectively).

Author	Study type [& sample size]	Event	Level of evidence ¹ & relevant critical appraisal criteria met [and not met]	Intervention & implementation	Funding	Outcomes
Waite ⁵⁴	Cross sectional study [NA]	2000 Olympics (Sydney)	Level 2- 4 [1 2 3 8 9]	NA	No funding received	Culture As a result of the prospect of (in 1998) hosting the Sydney Olympics, residents in the three most deprived (Western) SLAs (statistical local areas) were significantly ($p < 0.001$) more likely to feel a sense of community spirit, a sense of pride in Sydney and a feeling of pride in Australia as compared with the three most wealthy (Northern) Sydney SLAs. The mean feeling of community spirit was 1.39, pride in Sydney 1.33 and pride in Australia 1.36 in the deprived Western deprived SLAs as compared with 1.54, 1.50 and 1.53 in the Northern wealthy SLAs on a scale of 1 (strongly agree) to 2.5 (strongly disagree).

The critical appraisal criteria summarized from the three critical appraisal tools are shown below:

General critical appraisal criteria

- 1 = study design includes concurrent comparison groups (A2)
- 2 = study sample representative (B1)
- 3 = differences between groups accounted for (C1)
- 4 = statistical methods appropriate (C2)
- 5 = control for secular trend (C3)
- 6 = adequate data points (C4)
- 7 = control for regression to mean (C5)
- 8 = data collection method appropriate (D1)
- 9 = sampling and response adequate (E8)

Qualitative study critical appraisal criteria	10 = clear question suited to method (G1) 11 = data recording appropriate (G5) 12 = sampling, data collection and analysis appropriate to the method (G6) 13 = claims supported (G7)
Economic impact critical appraisal criteria	14 = underlying data valid (F1) 15 = uncertainty accounted for (F3 and F4) 16 = assumptions valid (F5 and F6)

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